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By

A.B. Graham

G.L. Goglia, Principal Investigator

Final Report

Prepared for the
National Aeronautics and Space Administration
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Hampton, Virginia

Under
Research Grant NSG 1309
Paul L. Coe, Jr., Technical Monitor
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By

A.B. Graham[1]

The NASA/Langley Research Center has initiated a broad research program for the development of a technology base for fighter aircraft capable of cruising without afterburner at supersonic speeds. Such configurations typically incorporate a low-aspect ratio, high-swept arrow-wing for which wind tunnel studies indicate high levels of aerodynamic efficiency at design Mach numbers on the order of 2.7. However, these configurations have generally exhibited relatively poor low-speed performance and stability and control characteristics. These low-speed deficiencies impose design constraints which penalize supersonic cruise performance. Although significant progress has been made in alleviating the low-speed deficiencies of supersonic cruise vehicles, additional research was required.

The research conducted through this grant included (1) experimental and analytical investigations using existing small- and large-scale models of supersonic cruise fighter vehicles to determine the effectiveness of airframe/propulsion integration concepts for improved low-speed performance and stability and control characteristics; and (2) the use of computer programs for engine/airframe sizing studies to yield optimum vehicle performance.

Since the contract became effective research has been conducted directly applicable to the Supersonic Cruise Fighter Aircraft program currently under study at NASA/Langley Research Center and,

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in particular, the Dynamic Stability Branch, Subsonic-Transonic Aerodynamics Division.

Past investigations and concept design iterations have resulted in a current baseline aircraft. The particular configuration which incorporates a highly-swept arrow-wing for efficient high-speed operation has exhibited several poor low-speed performance and stability and control characteristics. Work has been concerned with component static force tests and flow visualization and powered lift studies in an effort to identify the phenomena responsible for and to alleviate the low-speed deficiencies.

The research conducted to date has resulted in two publications. The first, a paper presented by Paul L. Coe, Jr., in November 1976 at the SCAR Conference held at Langley, was entitled "Results of Recent Research on Low-Speed Aerodynamic Characteristics of Supersonic Cruise Aircraft." The second is a proposed NASA TM-X tentatively entitled "Wind Tunnel Investigation to Determine the Effects of a Propulsive-Lift/Lateral-Control Concept on the Low-Speed Aerodynamic Characteristics of a Supersonic Cruise Vehicle."

The experimental research conducted under this grant has aided in the development of an airframe/propulsion integration concept having potential application to fighter aircraft capable of cruising efficiently at supersonic speeds.

A preliminary assessment of the results indicates that the particular airframe/propulsion integration concept is effective in alleviating the low-speed deficiences inherent to configurations designed for high aerodynamic efficiency at Mach numbers in the order of 2.7.

In order to provide a detailed analysis and documentation of these results, required for subsequent vehicle optimization studies, additional work will be necessary.

The research effort on supersonic cruise fighter vehicles has continued with some experimental research conducted using a large-scale model of a supersonic cruise vehicle. The vehicle incorporated a propulsion system which effectively integrated

the exhaust nozzle and trailing edge flap system. Preliminary evaluation of the results indicates that significant increases in low-speed lift and lateral control are obtainable, and that the airframe/propulsion concept minimizes many of the low-speed deficiencies associated with configurations designed for cruise Mach numbers on the order of 2.7.

A detailed trade study has been initiated in order to quantitatively define the overall mission improvements provided by vehicle optimization of the airframe/propulsion integration scheme.